

***Abstract***

Nanotube on gate FET structures and applications of such, including  $n^2$  crossbars requiring only  $2n$  control lines. A non-volatile transistor device includes a source region and a drain region of a first semiconductor type of material and a channel region of a second semiconductor type of material disposed between the source and drain region. A gate structure is made of at least one of semiconductive or conductive material and is disposed over an insulator over the channel region. A control gate is made of at least one of semiconductive or conductive material. An electromechanically-deflectable nanotube switching element is in fixed contact with one of the gate structure and the control gate structure and is not in fixed contact with the other of the gate structure and the control gate structure. The device has a network of inherent capacitances, including an inherent capacitance of an undeflected nanotube switching element in relation to the gate structure. The network is such that the nanotube switching element is deflectable into contact with the other of the gate structure and the control gate structure in response to signals being applied to the control gate and one of the source region and drain region. Certain embodiments of the device have an area of about  $4F^2$ . Other embodiments include a release line is positioned in spaced relation to the nanotube switching element, and having a horizontal orientation that is parallel to the orientation of the source and drain diffusions. Other embodiments provide an  $n^2$  crossbar array having  $n^2$  non-volatile transistor devices, but require only  $2n$  control lines.